Clean Air: An Act That Works

Prepared by the Office of Representative Henry A. Waxman

Special Issue

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THE FIVE-YEAR ANNIVERSARY OF THE CLEAN AIR ACT AMENDMENTS OF 1990

Five years ago, on November 15, 1990, President Bush signed into law the Clean Air Act Amendments of 1990. As finally enacted, the 1990 Amendments had broad bipartisan support, passing by overwhelming majorities in both the House (401 to 25) and the Senate (89 to 10). Enactment of the 1990 Amendments culminated ten years of congressional debate and controversy, making the Amendments one of the longest, most scrutinized, and hardest fought legislative battles in recent history.

The 1990 Amendments addressed six major air pollution problems: (1) widespread urban smog in major cities during the summer; (2) widespread carbon monoxide pollution in major cities during the winter; (3) particulate pollution; (4) emissions of hazardous air pollutants; (5) acid rain; and (6) depletion of the stratospheric ozone layer.

This special issue of "Clean Air: An Act that Works" examines the effectiveness of the 1990 Amendments in addressing these six air pollution problems over the last five years. In each instance, although more work remains to be done, significant progress toward the goals of the 1990 Amendments has been achieved -- at an economic cost far less than predicted by industry.

OVERVIEW

Environmental Progress. The 1990 Amendments have substantially reduced each of the six major air pollution problems that confronted the United States in 1990. Specifically:

- Over 50% of the cities that did not meet the air quality standard for urban smog in 1990 (55 out of 98 areas) now meet the standard.
- Over 75% of the cities that did not meet the air quality standard for carbon monoxide in 1990 (33 out of 42 areas) now meet the standard.
- Over 50% of the areas that did not meet the air quality standard for particulate matter in 1990 (37 out of 73) now meet the standard.
- Toxic emissions have been reduced by 1.6 billion lbs/yr since 1990 -- more than six times the reductions achieved from 1970 to 1990 under the original Clean Air Act.
- Sulfur dioxide emissions, the principal cause of acid rain, have been reduced by 2.6 million tons since 1990.
- U.S. production of chemicals that deplete the stratospheric ozone layer has been reduced by over 90% since 1990.

Economic Costs. These major air quality benefits have been achieved at costs far less than industry estimated -- and without any of the serious economic dislocations predicted by industry. Specifically:

- Overall costs of compliance with the 1990 Amendments are now estimated to be only $22 billion annually when the law is fully implemented in 2005 -- far less than the $51 billion to $91 billion estimated by industry in 1990.

- The cost of an acid rain "allowance," which is the right to emit one ton of sulfur dioxide, is just $140 -- nearly an order of magnitude lower than the $1,000 to $1,500 estimated by industry.

- The phaseout of ozone-depleting chlorofluorocarbons (CFCs) has been completed without any of the "severe economic and social disruption" predicted by DuPont in 1990.

- Auto makers are meeting the new tailpipe standards in the 1990 Amendments -- despite Ford's 1989 testimony that "we just do not have the technology to comply."

- Reformulated gasoline requirements went into effect this year without the "major supply disruptions" predicted by Mobil in 1990 -- and gas prices are now lower than in 1990.

Organization of this Report. The remainder of this special issue of "Clean Air: An Act that Works" is divided into seven sections. The first six sections discuss the success of the 1990 Amendments in addressing each of the six major air pollution problems. The final section discusses the economic costs of the 1990 Amendments.

URBAN SMOG REDUCTIONS

The 1990 Amendments have significantly reduced levels of urban smog, the most widespread air pollution problem in the U.S. Since 1990, over half of the nonattainment areas in the U.S. have met the Clean Air Act's health-based air quality standards for smog.

The Health Risk. Ground-level ozone pollution (commonly known as smog) harms the respiratory system. Ozone is a highly reactive gas that forms when emissions of volatile organic compounds (VOCs) and nitrogen oxides (NOx) combine in the presence of sunlight. Exposure to ozone can reduce lung function, cause chest pain and cough, and worsen the effects of bronchitis, emphysema, and asthma. High ozone levels are associated with increased hospital admissions for respiratory illnesses, particularly asthma. Permanent lung damage may also result from long-term exposure to ozone.

25 Years Ago. Emissions from motor vehicles and industrial sources of VOCs and NOx were essentially uncontrolled. Virtually every major U.S. city exceeded the current ozone standard.

1990. Before 1990, success in meeting the federal health standard for ozone was limited. Although VOC emissions dropped in the 1970s due to new motor vehicle controls, further reductions in the 1980s were offset by increases in the number of miles driven. NOx emissions actually increased over 10% from 1970 to 1990. And hotter summer temperatures in the late 1980s produced record-breaking ozone levels in many areas. When Congress passed the 1990 Clean Air Amendments, there were 98 ozone nonattainment areas in the U.S., with a combined population of 140 million.

Today. Since passage of the 1990 Amendments, the nation has made significant progress in reducing ozone levels. Over half of the nonattainment areas (55 out of 98), with a combined population of over 40 million, now meet the ozone standard. Despite high temperatures, preliminary data indicates that 1995 had significantly lower ozone levels than in the 1980s.

This progress has been achieved at the same time that the U.S. has experienced considerable

economic growth. Since 1970, VOC emissions have been cut 32%. At the same time, the U.S. population has increased 27%; the gross national product, 90%; and vehicles miles traveled, 111%. Experts estimate that without the Clean Air Act, VOC emissions today would be double 1970 levels.

Why the Clean Air Act Is Working. Emissions come from so many different sources that no single control measure can explain the success in reducing ozone levels. Federal motor vehicle standards have reduced VOC and NOx emissions from new motor vehicles by 97% and 90%, respectively. State and local controls on stationary sources have cut VOC emissions from large industrial sources by 80% since 1970. Of special importance since 1990, new federal requirements in the 1990 Amendments to clean-up fuels have reduced emissions from existing motor vehicles, the largest single source of VOC and NOx emissions in urban areas, by 20% in heavily polluted areas.

CARBON MONOXIDE REDUCTIONS

The 1990 Amendments have significantly reduced levels of carbon monoxide, the most widespread air pollutant in the winter. Since 1990, over 75% of the cities that exceeded the federal standard for carbon monoxide have come into compliance with the federal standard.

The Health Risk. Carbon monoxide (CO) reduces the ability of the blood to deliver oxygen to the body, because CO "mimics" oxygen by binding with hemoglobin, thereby interfering with the transport of oxygen. Exposure to low levels of CO is most dangerous for persons with heart disease; it aggravates angina (heart pain) and may trigger heart attacks. At higher CO levels, healthy individuals can suffer impaired visual perception, manual dexterity, and learning capacity. At extremely high levels (such as those caused by running a car in an enclosed garage), CO causes death by asphyxiation.

25 Years Ago. When the Clean Air Act was first enacted in 1970, about 130 million tons of CO were emitted into the air each year -- about 90 million tons from cars and trucks and 40 million tons from other sources. In the early 1980's, when reliable, uniform monitoring data first became available nationwide, 78 urban areas exceeded the air quality standard for CO.

1990. When Congress passed the Clean Air Act Amendments of 1990, 42 areas of the country, with a combined population of over 55 million, violated the CO standard.

Today. Nationally, carbon monoxide emissions have been reduced by 23% since 1970 -- despite a doubling in the number of miles driven by motor vehicles. Remarkably, only 9 of the 42 cities continued to violate the CO standard in 1994.

Why the Clean Air Act Is Working. Reductions in CO emissions from new cars, which beginning in 1975 were required to use catalytic converters, have caused much of long term reductions in CO emissions. Cars emitted 70% less CO in 1990 than in 1970.

Since 1990, important additional reductions have been achieved through new controls on wintertime emissions. In cold weather, CO emissions rise because fuel combusts more inefficiently and pollution controls function less effectively. To control these emissions, the 1990 Amendments required 36 nonattainment cities to add oxygen to gasoline from November to February in order to enhance fuel combustion. These fuel changes reduced CO emissions from motor vehicles by 32% and helped bring many of the cities into attainment. In addition, beginning in model year 1994, new vehicles are required to meet new cold-weather tailpipe standards, which will reduce cold-weather CO emissions by another 13% per vehicle.

PARTICULATE MATTER REDUCTIONS

The 1990 Amendments established a new program to reduce emissions of air-borne microscopic particles under 10 microns in diameter (called "PM-10"). Since 1990, over half of the areas in violation of the federal health standard for PM-10 have come into compliance.

The Health Risk. PM-10 is comprised of small particles that are released into the atmosphere from motor vehicle exhaust; emissions from power plants and industrial sources; wood stoves; and many other sources. Due to the particles' small size, they evade the body's natural defenses and can lodge in the most fragile portions of the lungs. PM-10 pollution can produce an array of serious health impacts, including reductions in lung capacity, aggravation of pre-existing respiratory ailments, cancer, and even death.

New epidemiological studies suggest that the current national ambient air quality standard for PM-10 may not be protective of human health. These studies have linked PM-10 pollution at levels below the current standard with tens of thousands of premature deaths.

25 Years Ago. The original national ambient air quality standard for particulate matter was based on "total suspended particulates" (TSP), which measured any particles floating in the air. In 1987, EPA changed the standard to PM-10, because most of the health risk from particulate pollution is caused by particles smaller than 10 microns in diameter. As a result, there is little available data about PM-10 levels in 1970.

1990. When Congress passed the 1990 Amendments, 73 areas with a combined population of 25 million violated the PM-10 standard. The new PM-10 program in the 1990 Amendments required moderately polluted areas to impose reasonably available pollution controls on PM-10 sources. Seriously polluted areas were required to use the best available pollution controls.

Today. Of the 73 areas in violation of the PM-10 standard in 1990, 37 now meet the standard, including Chicago, Seattle, and Boise.

Why the Clean Air Act Is Working. PM-10 levels have been reduced through a combination of mandatory and voluntary efforts. For example, in Klamath Falls, Oregon, extraordinarily high PM-10 levels that exceeded the federal standard by a factor of five were reduced below the standard by a combination of a voluntary wood-burning curtailment program and a program to replace polluting wood stoves with stoves meeting new EPA standards.

TOXIC EMISSION REDUCTIONS

One of the important innovations in the Clean Air Act Amendments of 1990 was a new, technology-based approach to controlling toxic emissions. Under this approach, the Environmental Protection Agency has issued 15 final toxic standards in the last five years, reducing toxic emissions by 1.6 billion pounds each year. In the previous 20 years, EPA had issued only 7 standards.

The Health Risk. The Clean Air Act lists 189 hazardous air pollutants. Examples of hazardous air pollutants include benzene, dioxin, mercury, and methyl isocyanate, the chemical that killed thousands in Bhopal, India. These toxic emissions can cause cancer, brain damage, reproductive disorders, birth defects, and other serious human health effects.

In addition, the toxic emissions contribute to the contamination of water bodies with toxic chemicals. The Great Lakes and many other waters are subject to health advisories warning against fish consumption as a result of this toxic contamination.

25 Years Ago. The 1970 Clean Air Act directed EPA to reduce toxic emissions to levels that protect public health with an "ample margin of safety." This risk-based standard proved nearly impossible to implement, because proposed regulations became mired in administrative dispute and litigation over the adequacy of the agency's risk assessments. The result was that EPA succeeded in issuing only seven toxic standards between 1970 and 1990. These standards reduced toxic emissions by just 0.25 billion lbs/yr.

There is no reliable data on aggregate toxic emissions in 1970. In fact, good data did not become available until 1989, when the congressionally mandated toxic release inventory showed that manufacturing facilities emitted 2.7 billion pounds of toxic pollutants in 1987.

1990. By 1990, when Congress was debating 1990 Clean Air Act Amendments, toxic emissions were estimated to cause 1,600 to 3,000 cancer cases each year. For residents living near large uncontrolled toxic sources, such as chemical plants, steel mills, and smelters, lifetime cancer risks from toxic emissions sometimes exceeded 1 in 1,000.

Congress responded to these health threats by adopting a new approach to controlling toxic emissions. Under the new approach, emissions standards would be based on the "maximum achievable control technology" (MACT), which is defined as the degree of control achieved by "the best controlled similar source." The 1990 Amendments directed EPA to promulgate MACT standards for all major sources of toxic emissions over a phased ten-year period.

Today. Since 1990, EPA has issued 15 new MACT standards, including standards for the chemical industry, coke ovens, and oil refineries. These standards will reduce toxic emissions by 1.6 billion lbs/yr. In just the three-year period from 1990 to 1993, toxic emissions reported to the toxic release inventory by manufacturing facilities dropped over 25%. The new toxics standards will also result in the reduction of 1.7 million tons per year of volatile organic compounds (VOCs), a precursor to urban ozone pollution -- the equivalent of removing 38 million cars from the road (about 25% of all U.S. cars). EPA is on schedule to promulgate the remaining MACT standards by 2000.

Why the Clean Air Act Is Working. The technology-based approach in the 1990 Amendments has proven to be a major success. This approach has allowed EPA to sidestep endless bureaucratic debates and focus its resources instead on determining an achievable level of control at major sources of toxic pollution.

ACID RAIN REDUCTIONS

The 1990 Amendments created a new, market-based approach to reduce sulfur dioxide (SO2) emissions, the primary precursor of acid rain. By the end of 1995, the program will have reduced SO2 emissions by 2.6 million tons from 1990 levels -- at a small fraction of the cost predicted by industry. By 2000, when the program is fully effective, SO2 emissions will be reduced by an additional 3.9 million tons. EPA has estimated the health and environmental benefits of these reductions to be worth over $10 billion per year, more than five times the program's costs.

The Health and Environmental Threat. SO2 emissions, which form when fuel containing sulfur (mainly coal) is burned, are the major source of acid deposition. The SO2 emissions react in the atmosphere to form tiny acidic particles called acid aerosols or sulfates, which can remain airborne for hundreds of miles. "Acid rain" and other forms of acid deposition occur when these acid aerosols settle or are washed out of the atmosphere.

Acid aerosols and acid deposition cause many serious adverse impacts. Acid aerosols irritate the lungs, constrict breathing, and have been linked in epidemiological studies of PM-10 pollution to 40,000 to 80,000 premature deaths each year. These aerosols also impair visibility, causing a 50% drop in summertime visibility throughout the East Coast. Acid deposition has acidified over 1,000 large lakes and thousands of miles of streams in the U.S. Acid deposition is also estimated to cause up to $2 billion annually in corrosion damage to man-made structures.

25 Years Ago. The 1970 Clean Air Act did not contemplate that long-distance transport of acid aerosols could cause widespread damage. Instead, the Act directed EPA to set an ambient air quality standard for SO2 that was designed to protect areas immediately adjacent to pollution sources. Ironically, this emphasis on reducing local pollution levels may actually have increased acid rain, because many coal-fired power plants (the principal source of SO2 emissions) responded by building tall smokestacks to disperse their emissions over long distances.

1990. Congress began serious consideration of acid rain legislation in 1983, but it was not until seven years later that it finally enacted an acid rain title as part of the Clean Air Act Amendments of 1990. The new acid rain title caps emissions from power plants at 8.95 million tons by the year 2000, half their 1980 levels. Under a novel market-based approach, each utility is given a fixed number of SO2 emission "allowances," which can traded among utilities to minimize compliance costs. The 1990 Amendments also required desulfurization of diesel fuel and placed a cap on SO2 emissions from industrial sources -- producing a combined reduction of 10 million tons of SO2 from 1980 levels (6.5 million tons from 1990 levels).

Today. On January 1, 1995, the first phase of the acid rain program went into effect, reducing emissions from the 110 dirtiest power plants. By the end of the year, SO2 emission will be reduced by 2.6 million tons from 1990 levels. The cost-per-ton of these reductions, as measured by the market price of allowances, is $140, far less than the $1,000 to $1,500 cost predicted by industry in 1990. The second phase of the program begins on January 1, 2000, and will reduce SO2 emissions by an additional 3.9 million tons annually.

Why the Clean Air Act Is Working. The market-based SO2 reduction program has left power plants free to select the most inexpensive strategy for meeting the overall SO2 emissions targets. Costs have further been reduced by cuts in the cost of SO2 "scrubbers," which remove SO2 from the smokestack, discoveries of new supplies of low-sulfur coal, and reduced rail tariffs.

PRESERVING THE OZONE LAYER

In a law with many success stories, the success of the program in the 1990 Amendments to preserve the stratospheric ozone layer is especially remarkable. Since enactment of the 1990 Amendments, U.S. production of ozone-depleting chemicals has been reduced over 90%.

The Health and Environmental Threat. Man-made chlorine- and bromine-containing chemicals such as chlorofluorcarbons (CFCs) destroy ozone in the stratosphere. This causes a large "ozone hole" to open up over the Antarctic each winter. It is also causing ozone levels over the mid-latitudes to decline at a rate of 4% to 5% per decade.

The destruction of the stratospheric ozone layer has potentially dire consequences. Ozone in the stratosphere (6 to 30 miles above the earth's surface) forms a protective shield that filters out dangerous ultraviolet radiation (UV-B). Every 1% decline in the ozone layer is estimated to cause the incidence of skin cancers to increase by 2%. Increased penetration of UV-B radiation also damages crops and aquatic systems, suppresses the human immune system, and ironically increases the formation of ozone in the lower atmosphere, where it is the primary ingredient of urban smog.

The Montreal Protocol. The threat to the ozone layer was first reported in 1974 by two Nobel laureates, Drs. Sherwood Rowland and Mario Molina. Thirteen years later, President Reagan and other world leaders responded to the mounting evidence of ozone depletion by signing the Montreal Protocol, which called for a 50% reduction in the production of certain ozone-depleting substances by 1998. In June 1990, President Bush signed amendments strengthening the Montreal Protocol. These changes called for a phaseout of production of CFCs, halons, and other ozone-depleting chemicals by 2000 to 2004.

The Clean Air Act. The Clean Air Act Amendments of 1990 implemented and further strengthened the provisions of the revised Montreal Protocol. New title VI of the Clean Air Act established a faster phaseout schedule for U.S. production of the major ("class I") ozone-depleting chemicals than required in the amended Protocol; created a new program to phaseout production of "class II" chemicals with lesser effects on the ozone layer; and required recycling of existing stocks of ozone-depleting chemicals to limit future releases.

In February 1992, President Bush announced that the U.S. would accelerate the phaseout of CFCs under the Clean Air Act to December 31, 1995. In November 1992, the Montreal Protocol was amended to incorporate the accelerated CFC phaseout proposed by President Bush, as well as a requirement to phase-out halon production by December 31, 1993.

The Situation Today. Under the Clean Air Act, U.S. production of ozone-depleting chemicals has dropped dramatically -- to less than 7% of 1986 levels by the end of 1995. As a result of these reductions and similar reductions abroad, atmospheric concentrations of ozone-depleting chemicals peaked in the lower atmosphere in 1994. (Due to the delay before these chemicals reach the upper atmosphere, the depletion of the stratospheric ozone layer will not peak until 1998 to 2000.) If current trends continue, the ozone layer will return to natural levels by 2050, preventing an estimated 300 million cases of skin cancer in the U.S by 2075.

Why the Clean Air Act Is Working. The lead times provided in the Clean Air Act, combined with the certainty of an eventual phaseout, gave DuPont and other chemical companies the opportunity and incentive they needed to develop substitutes to ozone-depleting chemicals. User groups also adapted rapidly. The electronics industry, for instance, successfully avoided the use of ozone-depleting solvents by developing "no-clean" technologies, while the refrigeration industry eliminated the use of CFCs through new high-efficiency designs.

ECONOMIC COSTS

As described above, the Clean Air Act Amendments of 1990 have significantly reduced air pollution in the U.S. These emission reductions have been achieved at reasonable economic costs and with none of the severe dislocations predicted by industry.

Overall Compliance Costs. In August 1990, the Clean Air Working Group, the principal business lobby fighting the Clean Air Amendments of 1990, estimated that the 1990 amendments would cost industry between $51 billion to $91 billion a year.

In fact, compliance costs are now estimated by EPA to be just $22 billion annually upon full implementation of the law in 2005 -- 57% to 75% lower than industry calculated (and nearly 10% lower than the Bush Administration estimated in 1990).

Acid Rain Control. Electric utilities fighting the new market-based acid rain provisions in the 1990 amendments estimated that the cost of an "allowance," the right to emit one ton of sulfur dioxide, would range between $1,000 and $1,500. In fact, the cost of an SO2 allowance is now just $140 -- nearly an order of magnitude less than industry estimated.

Even the Bush Administration's estimates of acid rain costs, which were regarded at the time as optimistic, have proven to be significantly inflated. In 1990, the Administration estimated that the annualized compliance costs would be $4 billion a year. In fact, the costs are now estimated by the congressional General Accounting Office to be just $2 billion annually -- 50% lower than the Administration calculated.

Preservation of the Stratospheric Ozone Layer. In January 1990, the DuPont Company testified that accelerating the phaseout of ozone-depleting CFCs to July 1, 1996, would cause "severe economic and social disruption." At the same hearing, the Air-Conditioning and Refrigeration Institute testified that it was "certain" that "the large installed inventory which we depend upon in this country cannot survive. ... We will see shutdowns of refrigeration equipment in supermarkets. ... We will see shutdowns of chiller machines, which cool our large office buildings, our hotels, and hospitals."

In fact, the phaseout of CFC production has been accelerated to December 31, 1995, with none of the severe dislocation predicted by industry. To their credit, DuPont and other companies helped make the accelerated phaseout possible by rapidly developing alternatives to CFCs.

Motor Vehicle Standards. In May 1989, Ford Motor Company testified that "we just do not have the technology to comply" with the first tier of new tailpipe standards in the 1990 Amendments, not even with technology "on the horizon."

In fact, the motor vehicle industry began making vehicles that meet the new standards in 1993. Engineers for the car companies now say the new standards triggered the development of sophisticated engine-control equipment, resulting in three benefits once thought incompatible: low pollution, more power, and better fuel economy. Indeed, in an effort to forestall electric vehicle requirements, the industry has even proposed accelerating the more stringent "tier II" motor vehicle standards in the 1990 Amendments from 2003 to 1997.

Reformulated Gasoline. In October 1990, Mobil Corporation opposed the new Clean Air Act requirements for reformulated gasoline, writing that "the technology to meet these standards simply does not exist today" and predicting "major supply disruptions."

In fact, reformulated gasoline requirements went into effect this year in the nation's most polluted cities, without significant supply disruptions. The price of gasoline today is less than the price in 1990.

Stage II Vapor Recovery. In May 1989, the Petroleum Marketers Association of America testified that installing "stage II" vapor-recovery hoses at gasoline stations would cost between $16,000 to $60,000 per station, depending on the size of the station -- and "could drive many independent marketers to financial failure."

In fact, costs have ranged from $5,500 to $23,000 -- approximately one-third the cost estimated by industry. There has been no widespread failure of gas stations.

CONCLUSION

The Clean Air Act Amendments of 1990 have made a significant impact on the quality of the nation's air. In the last five years, each of the six major air pollution problems facing the United States in 1990 have measurably improved -- at economic costs that have been substantially lower than expected.